SUMMARISED REPORT

OF THE

PLAGUE RESEARCH LABORATORY,

FOR

1902-1904.

and Bacteriological Laboratory 173

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SUMMARISED REPORT

OF THE

PLAGUE RESEARCH LABORATORY,

FOR

1902-1904.

LIBRARY OF THE BOMBAY BRANCH OF THE ROYAL ASIATIC SOCIETY

X.1
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No. D-891 of 1904.

From

W. M. HAFFKINE, Esq., C.I.E.,
Director-in-Chief,
Plague Research Laboratory;

To

The SECRETARY to GOVERNMENT,
General Department (Plague),
Bombay.

Plague Research Laboratory;
Parel, Bombay, 21st April 1904.

Sir,

I have the honour to forward, for Government's favourable consideration, attached Summarised Report on the working of this Laboratory from the 1st June 1902 to the 31st March 1904, forming continuation of the Report submitted to you with this office No. $\frac{1}{S.C.}$ of 21st March 1903 for the period 8th October 1896 to 31st May 1902.

I have the honour to be,

Sir,

Your most obedient servant,
W. M. HAFFKINE,
Director-in-Chief,
Plague Research Laboratory.

SUMMARISED REPORT

OF THE WORK DONE IN THE

BOMBAY PLAGUE RESEARCH LABORATORY,

FOR 1902—1904.

LIBRARY OF THE BOMBAY BRANCH OF THE ROYAL ASIATIC

I.

RESEARCH AND PRACTICAL WORK ON PLAGUE.

(1).—THE PLAGUE PROPHYLACTIC.

(A.)

During the 22 months under review, *i. e.*, between the 1st June 1902 and 31st March 1904, 2,890,184 doses of prophylactic were manufactured and issued on indents from India and abroad. 2,869,097 went to places in India and 21,087 to other countries.

Within India the material was distributed as follows :—

	Number of doses supplied.
The Punjáb	2,501,128
The Native States	169,441
The Bombay Presidency and Sind	73,540
United Provinces of Agra and Oudh	29,376
Central Provinces	27,013
Bengal and Behar	25,428
Berárs	21,048
The Madras Presidency	13,094
Central India	4,581
Assam	3,005
Coorg	735
Burma	505
Rájputána	203

Of the countries abroad—

13,977 doses went to Asia outside India,
6,104 „ to Australia,
1,006 „ to Africa.

The total number of doses of prophylactic issued from the Laboratory, since the commencement of plague inoculation on 10th January 1897, is 5,757,225 doses, of which 5,252,259 went to India and 504,966 abroad. In India, the Punjáb was the largest consumer (3,332,667 doses). Then follow in order of the number of doses supplied: The Bombay Presidency and Sind (1,056,938 doses), the Native States (488,074 doses), Bengal and Behar (102,588), the Madras Presidency (99,011), the United Provinces of Agra and Oudh (70,842), the Central Provinces (40,150), Berar (25,823), the Portuguese territory (11,137), Rájputána (11,034), Central India (5,913), Assam (4,241), Burma (3,462), Coorg (279) and the North-Western Frontier Province (100 doses).

Outside India 219,776 doses went to Africa, 162,147 to Australia, 60,745 to Asia, 55,315 to Europe, 5,720 to Australasia, and 1,263 to America.

Sub-joined is a statement showing the geographical distribution of the plague prophylactic during the year under review.

Statement showing the amount of Plague Prophylactic supplied to various places from the Plague Research Laboratory, Bombay, between 1st June 1902 and 31st March 1904.

(Total 2,890,184 adult doses.)

Name of Town or Village.	Name of Presidency and District and date of despatch.	Number of Doses.
	BOMBAY PRESIDENCY AND SIND.	
Bombay ...	... 5th June 1902 to 31st March 1904.	5,266
	Ahmednagar District.	
Ahmednagar	... 25th November 1902 to 14th January 1904.	14,791
Visápur	... 16th February 1904 ...	1,000
	Ahmedabad District.	
Ahmedabad	... 2nd March 1903 to 22nd March 1904.	553
Paránti j ...	... 25th February 1904 to 30th March 1904.	1,082
	Belgaum District.	
Belgaum...	... 13th June 1902 to 10th October 1903.	5,244
	Broach District.	
Broach ...	... 11th September 1903 to 14th September 1903.	352
	Bijápur District.	
Bádámi ...	... 21st February 1903	504
Bijápur ...	... 3rd October 1903 to 23rd October 1903.	2,011
	Dhárwár District.	
Dhárwár...	... 21st June 1902 to 3rd December 1903.	4,623
Gadag ...	... 28th October 1902 to 5th November 1903.	2,527
Hubli ...	... 28th July 1902 to 26th October 1903.	7,199
Nargund	... 2nd September 1902	2,012
Ron ...	... 8th August 1903	501
	SIND DISTRICT.	
	Hyderabad.	
Hyderabad	... 1st September 1903	101
	Kaira District.	
Anand ...	... 23rd November 1902 to 22nd March 1904.	1,659
Borsad ...	... 5th August 1902 to 8th March 1904.	1,545
	Karáchi District.	
Karáchi ...	... 21st April 1903 to 24th March 1904.	410
	Kánara District.	
Halyál ...	... 23rd November 1902 to 6th January 1903.	2,004

Name of Town or Village.	Name of Presidency and District and date of despatch.	Number of Doses.
	BOMBAY PRESIDENCY AND SIND—*continued.*	
	Khándesh District.	
Bhusával	... 5th December 1902	32
Dhulia ...	... 8th September 1902 to 5th February 1904.	6,544
Nandurbár	... 24th November 1902	105
	Násik District.	
Manmád ...	... 30th August 1902	96
Násik ...	... 28th September 1902... ...	101
	Panch Mahals District.	
Godhra ...	... 18th September 1903... ...	101
	Poona District.	
Junnar ...	... 23rd February 1903	107
Kirkee ...	... 24th September 1902 to 10th November 1903.	2,073
Poona ...	... 19th August 1902 to 18th January 1904.	7,070
Sirur ...	... 27th October 1903	303
Yerrowda	... 5th February 1903 to 9th March 1904.	2,056
	Ratnágiri District.	
Ratnágiri	... 17th September 1902 ...	405
	Sholápur District.	
Bársi	... 30th September 1903 ...	201
Sholápur	... 30th January 1903 ...	205
	Surat District.	
Surat	... 21st January 1903 ...	203
	Sátára District.	
Sátára	... 24th November 1902 to 11th November 1903.	495
	Thána District.	
Bándra	... 27th January 1903 ...	59
	Total for Bombay Presidency and Sind.	73,540
	ASSAM.	
Cachar	... 18th June 1903	252
Dhubri	... Do.	251
Dibrugarh	... 22nd May 1903 to 13th June 1903.	540
Gauhati	... 9th June 1903 to 18th June 1903.	456
Goalpara	... 14th December 1903 ...	250
Nowgong	... 18th June 1903	250
Sibsagar	... Do.	252
Shillong	... Do.	250
Sylhet	... Do.	252
Tezpur	... Do.	252
	Total for Assam ...	3,003

Name of Town or Village.	Name of Presidency and District and date of despatch.	Number of Doses.
	BENGAL PRESIDENCY.	
Arrah Chowk	... 3rd March 1903 ...	101
Bhagalpore	... 23rd December 1902 to 25th February 1904.	1,406
Bankipur	... 25th November 1902 to 2nd October 1903.	1,247
Calcutta	... 23rd October 1902 to 13th November 1903.	1,314
Chupra Saran	... 6th January 1903 to 4th September 1903.	9,920
Chumparan	... 16th December 1902 ...	502
Gaya	... 31st January 1903 to 18th January 1904.	7,533
Muzafarpur	... 26th November 1902 to 29th March 1904.	921
Monghyr	... 15th March 1904 ...	12
Patna	... 26th November 1902 to 2nd February 1903.	2,370
Puri	... 17th June 1903	102
	Total for Bengal Presidency.	25,428
	BERARS.	
Akola	... 26th November 1902 to 21st January 1904.	1,886
Anjangaon	... 31st August 1903 ...	500
Amraoti	... 24th November 1902 to 19th February 1904.	5,786
Basim	... 7th January 1903 to 24th October 1903.	517
Buldana	... 1st October 1902 to 8th August 1903.	2,937
Chandar Bazar	... 31st August 1903 ...	503
Chikalda	... 16th October 1903 to 24th March 1904.	932
Daryapur	... 31st August 1903 to 24th March 1904.	1,006
Dharni	... 16th October 1903 ...	502
Ellichpur	... 27th October 1903 to 24th March 1904.	5,319
Jalna	... 4th November 1903 to 16th January 1904.	1,058
Wun	... 8th October 1903 ...	102
	Total for Berars ...	21,048
	BURMA.	
Rangoon	... 18th April 1903 ...	505
	Total for Burma ...	505
	CENTRAL INDIA.	
Mhow	... 23rd March 1903 to 24th October 1903.	3,067
Rutlam	... 25th November 1902 to 22nd September 1903.	509
Ujjain	... 26th December 1903 ...	1,005
	Total for Central India ...	4,581
	CENTRAL PROVINCES.	
Biláspur	... 7th January 1903 ...	500
Bhandára	... 7th January 1903 to 29th January 1904.	954
Balaghat	... 8th January 1903 to 5th December 1903.	1,002
Betual	... 7th January 1903 ...	502
Buldána	... 29th January 1903 ...	502
Chanda	... 9th January 1903 ...	499

Name of Town of Village.	Name of Presidency and District and date of despatch.	Number of Doses.
	CENTRAL PROVINCES—*continued.*	
Chhindwara	... 9th January 1903 to 27th January 1904.	1,006
Chupra Seoni	... 6th January 1903 ...	502
Damoh	... 7th January 1903 ...	502
Hoshangabad	... 7th January 1903 to 24th November 1903.	802
Hurda	... 5th November 1903 to 25th March 1904.	155
Jabbalpore	... 23rd December 1902 to 4th September 1903.	1,806
Kampti	... 20th October 1902 to 19th January 1903.	696
Mandla	... 9th January 1903 ...	502
Mohapani	... 20th November 1903 ...	30
Nimar	... 8th January 1903 to 7th December 1903.	1,006
Nágpur	... 8th January 1903 to 19th January 1904.	10,210
Narsingpur	... 5th January 1903 to 26th November 1903.	1,612
Raipur	... 7th January 1903 to 29th January 1903.	1,504
Sambalpore	... 7th January 1903 ...	502
Saugor	... 27th December 1902 to 7th December 1903.	1,513
Wardha	... 23rd December 1902 to 21st December 1903.	706
	Total for Central Provinces.	27,013
	COORG.	
Mercara	... 16th May 1903 to 18th July 1903.	466
Sidapur	... 18th October 1902 to 6th June 1903.	269
	Total for Coorg ...	735
	MADRAS PRESIDENCY.	
Cannanore	... 7th August 1902 to 13th August 1903.	1,456
Coonoor	... 11th March 1903	505
Madras	... 25th November 1902 to 19th January 1904.	9,052
Mangalore	... 15th August 1902 to 28th April 1903.	2,004
Munaar	... 20th January 1904 ...	50
Raichur	... 30th December 1902 ...	27
	Total for Madras Presidency.	13,094
	THE PUNJAB.	
Amritsar	... 8th September 1902 to 4th December 1902.	15,573
Batala	... 8th March 1904... ...	128
Delhi	... 25th November 1902 ...	500
Ferozepore	... 4th September 1902 to 15th July 1903.	17,219
Gujranwalla	... 31st July 1902 to 18th October 1902.	10,057
Gurdaspur	... 1st October 1902 to 29th October 1902.	17,031
Hoshiarpur	... 4th October 1902 to 29th October 1902.	13,097
Jullundur	... 15th July 1902 to 10th March 1904.	2,328,279
Kasauli ...	... 15th August 1902 to 21st October 1902.	848

Name of Town or Village.	Name of Presidency and District and date of despatch.	Number of Doses.
	THE PUNJAB—*continued.*	
Kohat ...	... 7th January 1903	101
Ludhiána...	... 23rd August 1902 to 29th October 1902.	8,460
Lahore ...	... 4th October 1902 to 29th October 1902.	12,605
Moga ...	... 14th June 1902	10,052
Murree ...	... 10th October 1902	55
Sanawar ...	... 27th October 1902	101
Sialkot ...	... 4th August 1902 to 29th October 1902.	36,179
Sabathu ...	... 11th August 1902 to 2nd September 1902.	434
Umballa ...	... 8th September 1902 to 10th October 1902.	30,409
	Total for the Punjab ...	2,501,128
	RA'JPUTA'NA.	
Nasirabad	... 2nd September 1903 ...	203
	Total for Rájputána ...	203
	UNITED PROVINCES OF AGRA AND OUDH.	
Aligarh ...	... 15th April 1903	608
Allahabad	... 3rd September 1902 to 6th January 1903.	1,852
Azamgarh	... 29th November 1902 to 18th February 1904.	327
Banda ...	... 2nd October 1902	105
Barabanki	... 14th April 1903 to 21st October 1903.	33
Bareilly ...	... 21st February 1903	122
Benares ...	... 6th January 1903 to 29th March 1904.	378
Bulandshahr	... 27th April 1903	502
Cawnpore	... 21st August 1902 to 25th January 1904.	15,442
Dilkusha	... 11th February 1903	500
Dholpur	... 24th November 1902 ...	147
Farukabad	... 7th October 1902	1,011
Fatehpur	... 25th March 1903	90
Fyzabad ...	... 16th December 1902 to 27th October 1903.	1,302
Ghazipur	... 10th March 1904	45
Gonda ...	... 10th December 1902	12
Gorakhpur	... 9th March 1903	104
Jhansi ...	... 16th October 1902 to 20th March 1904.	366
Lucknow	... 29th September 1902 to 29th March 1904	3,752
Meerut ...	... 7th October 1902 to 26th March 1904.	1,835
Moradabad	... 22nd October 1902	490
Muttra ...	... *13th March 1904*	20
Shajahanpur	... *6th June 1902*	52
Saharanpur	... *6th January 1903*	104
Sitápur ...	... *20th December 1902 to 3rd December 1903.*	177
	Total for United Provinces of Agra and Oudh.	29,376
	NATIVE STATES.	
	Bombay Presidency.	
Baroda ...	... 1st February 1903 to 19th February 1904.	1,613
Bhávnagar	... 8th October 1902 to 5th October 1903.	355
Deesa ...	... 28th October 1903 to 30th October 1903.	707

Name of Town or Village.	Name of Presidency and District and date of despatch.	Number of Doses.
	NATIVE STATES—*contd.*	
	Bombay Presidency—contd.	
Jámnagar	... 15th December 1902... ...	200
Junágad	... 3rd June 1903	102
Miraj ...	... 7th August 1902 to 8th October 1903.	1,011
Mudhol ...	... 10th November 1903 ...	101
Rájkot ...	... 10th October 1902 to 22nd November 1902.	1,009
Rámdurg	... 16th October 1902 to 12th December 1902.	400
Sávnur ...	... 11th August 1902 to 12th December 1902.	158
Wadhwán	... 18th March 1904	101
	Total for Native States in Bombay Presidency.	5,757
	Bengal Presidency.	
Bharatpur	... 28th October 1902	503
Darbhanga	... 6th January 1903	1,019
	Total for Native States in Bengal Presidency.	1,522
	Central India.	
Agar ...	... 22nd October 1903	612
Bhopal ...	... 26th February 1903 to 12th February 1904.	7,531
Baghalkhand	... 5th October 1903	105
Bajrangarh	... 27th February 1904 ...	180
Dhar ...	... 24th March 1903	104
Goona ...	... 4th November 1903 to 27th January 1904.	2,109
Gwalior ...	... 21st January 1904 to 29th March 1904.	710
Indore ...	... 28th October 1902 to 9th March 1904.	16,030
Jaora ...	... 31st August 1903 to 13th March 1904.	7,494
Sirdarpur	... 28th November 1902 to 18th March 1904.	582
Neemuch	... 28th August 1903 to 8th March 1904.	1,921
Sailana ...	... 30th November 1903... ...	507
	Total for Native States in Central India.	37,885
	Kashmir.	
Jammu ...	... 22nd October 1902 to 12th February 1904.	2,502
Srinagar ...	... 22nd October 1902 to 9th February 1904.	13,473
Poonch ...	... 12th October 1903	500
	Total for Kashmir ...	16,475
	Madras Presidency.	
Bangalore	... 19th August 1902 to 29th March 1904.	29,083
Trivandrum	... 25th November 1902 to 8th January 1903.	5,012
	Total for Native States in Madras Presidency.	34,095

Name of Town or Village.	Name of Presidency and District and date of despatch.	Number of Doses.
	NATIVE STATES—*continued.*	
	Nizam's Territory.	
Aurangabad	... 9th October 1902 to 5th February 1904.	10,758
Bolarum ...	... 22nd September 1903 ...	418
Hyderabad	... 10th December 1902 to 23rd September 1903.	5,567
Jalna ...	... 27th October 1902 to 5th January 1903.	3,012
Secunderabad	... 2nd September 1902 to 25th November 1902.	668
	Total for Nizam's Territory.	20,423
	Rájputána.	
Bikaneer	... 25th November 1902 to 6th January 1903.	501
Banowara	... 12th March 1903 ...	1,003
Dholpur	... 3rd February 1904 ...	60
Jeypore	... 10th March 1903 to 3rd October 1903.	2,591
Kherwara	... 3rd March 1903 ...	52
Nimbahera	... 9th March 1903 ...	503
Shapura	... 17th February 1904 to 12th March 1904.	3,211
Ulwar	... 18th October 1902 to 5th February 1904.	23,239
	Total for Native States in Rájputána ...	31,160
	The Punjab.	
Jhind	... 29th August 1902 to 23rd October 1902.	4,532
Kapurthala	... 23rd October 1902 to 31st March 1904.	1,107
Malerkotla	... 10th October 1902 to 13th October 1902.	3,008
Nabha	... 6th June 1902 to 25th March 1903.	2,229
Patiala	... 5th October 1902 to 6th December 1902.	10,240
Sirmoor	... 8th October 1902 to 24th November 1902.	1,008
	Total for Native States in the Punjab.	22,124

Name of Town or Village.	Name of Presidency and District and date of despatch.	Number of Doses.
	COUNTRIES OUTSIDE INDIA.	
	ASIA.	
	Ceylon.	
Colombo	... 9th January 1903 to 1st March 1904.	4,015
	Turkey-in-Asia.	
Smyrna	... 29th September 1903 ...	144
	China.	
Foochow	... 25th January 1903 to 29th January 1904.	3,005
Hong Kong	... 3rd January 1903 ...	2,005
Peking	... 8th February 1904 ...	607
	Total for China ...	5,617
	Straits Settlements.	
Singapore	... 4th May 1903 to 22nd March 1904.	4,201
	AUSTRALIA.	
	New South Wales.	
Sydney	... 19th May 1903 ...	5,011
	New Caledonia.	
Noumea	... 18th September 1903 ...	1,093
	Total for Australia ...	6,104
	AFRICA.	
	Eastern Africa.	
Zanzibar	... 24th April 1903 ...	1,006
	Total for countries outside India.	21,087
	Grand Total ...	28,90,184

(B.)

The position of anti-plague inoculation as worked out in this Laboratory, in relation to other measures suggested and tried against the plague has been described in the Punjab Government's Memorandum to the Government of India, No. 567-S.P. of 30th June 1902. The document states as follows :—

"The segregation of patients and contacts under the conditions which are essential to the success of the measure is now entirely out of the question" (paragraph 2).

"Evacuation, though it may check an outbreak in a particular locality, is not a measure which will be of assistance in checking the extension of plague from one locality to another" (paragraph 2).

"Disinfection also is a measure that cannot be efficacious in checking plague. There remains then only inoculation, and it is extremely fortunate

that the experience which has been gained of its effects, and the practicability, which has been proved in the Punjab, of inducing the people to submit to it extensively in anticipation of an outbreak of plague, point to inoculation as a measure on which we are justified in placing considerable hope and reliance" (paragraph 2).

"Inoculation is the only measure that Government can hope to induce the people to adopt effectively on a scale at all adequate to the requirements of the situation" (paragraph 7).

"Inoculation can be brought within the reach of those whom we have to protect from plague at an expenditure of a little more than an anna and a quarter per head of population of the infected districts" (paragraph 31).

"The measure of inoculation now proposed holds out a promise that for the not immoderate expenditure of Rs. 8,64,000, the calamity under which the Punjab suffers may be immediately alleviated, while the extension of the disease may be stayed, and the serious consequences which must follow on its extension may be obviated. This is a promise that no other measure which is at present practicable, holds out to us" (paragraph 32).

Government are aware that the above were the considerations which guided me when introducing in 1897 the plague prophylactic inoculation as the measure for combating the plague epidemic (*vide* the references quoted in the "Summarised Report for the Bombay Plague Research Laboratory for 1896—1902," p. 11, B, initial section). As there was at the time universal opposition to these views, I had to take upon myself to make the following prediction: "On analysing the nature of the things, there remains no possibility of doubt that the programme contained in the above lines" (*i.e.*, my suggestion of modifying the segregation-disinfection plan in favour of those who underwent anti-plague inoculation) "will be adopted universally, though, it is certain, after a more or less prolonged expenditure of effort in many other directions, and after being lamentably retarded by the prevalent divergence of views." (Memorandum of 21st June 1898.)

Notwithstanding the many difficulties which the general adoption of this inoculation as the specific method of combating the epidemic has met with so far, I have no doubt that such an adoption will ultimately take place.

(C.)

The alterations introduced in the details of the manufacture of the plague prophylactic since my last Report, in accordance with the remarks made in the latter (*vide* "Summarised Report on the Plague Research Laboratory for 1896—1902," p. 12), were referred to in this office letters to you No. 1642 of 31st July, paragraph 3, No. 1749 of 12th August, and No. 3032 of 11th September 1902, paragraph 4; and described in detail in No. D—810 of 9th April 1904. During the period under review there was great demand for the material, and special adaptations had to be made to meet these. The urgency of the demands from the Punjab was explained by that government in letter No. 3199-S. of 14th October 1902 to the Government of India. The same was notified to the Laboratory in a great number of letters and telegrams of which the following may give an idea:—

State wire of 6th October 1902, from District Plague Medical Officer, Gujranwalla, to the Medical Officer in charge Plague Laboratory:—

"Please expedite compliance with my indent for brew for 6,000. Have in whole district sufficient only for fifteen inoculations."

Letter No. 59 of 9th October 1902, from same Officer to the Medical Officer in charge Plague Research Laboratory:—

"I have the honour to acknowledge the receipt of two boxes containing brew, and to request that brew may be sent weekly sufficient for the in-

oculation of 12,000 persons, and that when the Laboratory is able to supply the full number of 72,000 per day, the amount sent to be increased to 21,600 per week."

Urgent State wire of 10th October 1902, from Dr. Henry Fraser, Umballa, to Professor Haffkine :—

"4114-D. Please send two thousand doses prophylactic to Officer Commanding Bengal Lancers, Umballa, and kindly wire notice of despatch."

State wire of same date, from Civil Surgeon, Ludhiana, to Superintendent, Plague Research Laboratory :—

"Kindly despatch immediately here five thousand doses prophylactic serum, four 20 c.c. syringes, twenty spare needles, six barrels, twelve plungers for inoculation Melerkotla State, ordered by Government."

State urgent wire of 22nd October 1902, from Chief Medical Officer, Kashmir, Jamu, to the Director-in-chief, Plague Research Laboratory :—

"Please send immediately 2,000 doses fresh plague prophylactic railway station Jamu Tawi by passenger train."

Letter of 23rd October 1902, from Civil Surgeon, Ludhiana, to the Superintendent, Plague Research Laboratory :—

"5,000 doses were indented for, it is requested that at least 3,000 doses may be supplied as soon as possible."

Wire of 1st November 1902, from Chief Medical Officer, Kapurthala, to Superintendent, Plague Research Laboratory :—

"Send 5,000 fresh doses serum with two syringes and dozen needles."

State urgent wire of 6th November 1902, from District Plague Medical Officer, Umballa, to Superintendent, Plague Research Laboratory :—

"Please send 5,000 doses plague prophylactic at once."

Letter from same Officer, No. 157 of 7th November 1902, to the Superintendent, Plague Research Laboratory :—

"I have the honour to call your attention to the fact that the amount of serum prophylactic which is being received by this office is quite insufficient and much below the amount assigned to this district.

"I received 10,000 doses on the 1st October which lasted till the 18th October when the 1,000 doses per diem which have been fixed for this district began to arrive. This went on till the 27th October. From the 27th to the 31st October only 500 doses per diem were received from Bombay, while during November only 509 doses were received on the 4th November.

"I was only able to carry on owing to having a small stock of old material which has since become exhausted, and the Superintendent, Disinfection Depôt, Jullunder, has not been able to supply me, and I am quite unable to meet the present demand.

"I therefore beg to request that the proper amount (1,000 per diem) may be sent from the 27th October, and continued from that date, as that is the least we can do with owing to people coming forward more readily."

Letter No. 2595 of 25th November 1902, from Civil Surgeon, Buldana :—

"I have the honour to acknowledge two parcels Haffkine's plague serum. Plague is now appearing in many parts of this district and the people are constantly begging to be inoculated. I will take it as a personal favour if you would very kindly send me another 2,000 doses on as early a date as may be convenient, as the amount now so very kindly sent me will not go far and would be exhausted within 10 days. So I hope you may see your way to sending me say 2,000 doses more. If you cannot spare 2,000 straight off, then 1,000 *pro tem* would be thankfully received."

State wire of 28th November 1902, from Civil Surgeon, Amritsar, to Professor Haffkine :—

"Please send soon two thousand doses of new brew of plague prophylactic, old supply being returned."

Letter of 5th December 1902, from District Plague Medical Officer, Umballa, to the Superintendent, Plague Research Laboratory :—

"I have been informed that 30,000 doses of prophylactic will be shortly available and I have the honour to request that 10,000 doses or as near that amount as possible may be supplied to this district since the indications for demand among the people are very hopeful. I also beg to request that 1,500 doses per day may be supplied after the distribution of the aforesaid 30,000 doses during the rest of this month."

Letter No. 2503 of 12th November 1902, from Civil Surgeon, Buldana, to the Superintendent, Plague Research Laboratory :—

"I have the honour to bring to your notice that I have sent you several letters, *one registered* and two telegrams, requesting a supply of Haffkine's plague prophylactic serum and regret to say have not been favoured with the serum or even a reply.

"The people in this town are dying at the rate of 8 to 10 per day and I have daily calls from the population begging to be inoculated. I would take it as a personal favour if you will send as many doses of serum as you may be able to spare up to 2,000. I hope you will kindly send it me as early as possible. Send parcel by mail train or passenger, care of Mail Tonga Agent, Mulkapore, G. I. P. Railway. Send rail receipt to the Mail Tonga Agent to save delay. If you cannot supply immediately, will you write informing me when you may be able to do so, as the Deputy Commissioner is pressing."

For a certain time the amount of prophylactic turned out reached 80,000 doses a day.

It was when using the material prepared in September—October 1902 that 19 cases of tetanus occurred in the village of Malkowal, in the Punjab. Some 120,000 other people had by that time been inoculated with the same material, and the reports submitted from the Punjab and the rest of the country testified to the harmlessness, as well as the effective immunising properties of that material. (*Vide* information from the districts submitted with this office Nos. 7, 9 & 10/Confl., of 6th and 23rd December 1902 and 25th January 1903). The mortality from plague amongst those inoculated was reduced to a fraction of what it was in the non-inoculated, as will be seen below.

It is known that a very minute quantity of contaminated matter is required to cause tetanus. A surgical instrument, scrupulously clean, *i. e.*, containing no visible trace of impurity of any kind, may cause the disease, if not preliminarily sterilised. The experiments of Vaillard and Rouget (*Annales de l'Institut Pasteur*, 1892, pp. 406 and 417) showed that to cause to a guinea-pig death from tetanus, it is sufficient to inoculate it with a particle of earth in which cultivation reveals the presence of 2 or 3 tetanus germs only; animals injected with such a contaminated particle may exhibit a disease of equal severity, and all die in 3 to 5 days (pp. 415, 416).

The material used at Malkowal might have got contaminated either at the Laboratory or elsewhere.

The following facts were against the admission that the tetanus germs had got into the prophylactic in Bombay.

The cases of tetanus occurred in persons inoculated from a bottle belonging to brew 53 N of 19th September 1902. This bottle formed one of five filled from the same brew-flask, No. 53 N. That the brew was not contaminated was proved by the persons who were inoculated, at other places, with the remaining four bottles having had no tetanus.

A fluid in which tetanus germs had gained entrance and lived for some time gives out a foul odour which is felt at a distance by by-standers when the vessel is unstoppered.

The inoculators had no instruction to test bottles by smelling, but many of them did so. On this occasion, at Malkowal, the bottle, when opened for inoculation, six weeks after it had been prepared in the Laboratory, was smelt, and no odour was found in it.

A fortnight after the bottle was used it was again examined, and by that time a smell had developed in the remnants of the fluid. The microbe of tetanus was then also found in it, in symbiose with a micrococcus. (The tetanus bacillus, which requires the exclusion of fresh air for its development, grows well if another microbe happens to be present which uses up the air.)

In the course of the above large operations in the Punjab tetanus also occurred elsewhere than in Malkowal, but investigation showed clearly that the cause could not be imputed to the Laboratory, and it was not so imputed.

The Malkowal occurrence did not fortunately diminish the indents made on the Laboratory for prophylactic from Provinces outside the Punjab.

The following shows the issues of the material to places other than the Punjab for (1) the year of the Malkowal occurrence, (2) the year preceding and (3) the year following it.

The statement refers to the first nine months of the working year, *i.e.* for the period ending the 31st ultimo.

Months.	Number of doses indented for and issued in the working year previous to the Malkowal occurrence, *i.e.* 1901-1902.	Number of doses indented for and issued in the Malkowal year, *i.e.* 1902-1903.	Number of doses indented for and issued after the Malkowal year, *i.e.* 1903-1904.
July ...	6,362 including 1,711 sent outside India.	719	5,682 including 3,161 sent abroad.
August ...	8,157 „ 1,004 „	10,869	11,922 „ 1,093 „
September ...	4,927 „ 1,503 „	15,812	21,566 „ 204 „
October ...	11,802 „ 504 „	25,505 (the month of the Malkowal occurrence).	32,012 „ 102 „
November ...	15,708 „ 1,000 „	26,476	18,374 „ 78 „
December ...	14,907 „ 4,513 „	18,903	23,472
January ...	8,418 „ 536 „	46,849 including 4,016 sent abroad.	14,050 including 1,065 sent abroad.
February ...	7,902	15,175	12,062 „ 1,671 „
March ...	29,469 „ 21,127 „	25,001 „ 2,000 „	11,022 „ 1,560 „
Total...	1,07,652 „ 31,898 „	1,85,309 „ 6,016 „	1,50,162 „ 8,934 „

During the nine months of the present working year, *i.e.* the year following the Malkowal occurrence, the indents on the Laboratory from places outside the Punjab amounted thus to 150,162 doses, as against 107,652 doses of the same nine months of the year preceding that occurrence. The former total includes 8,934 doses indented for from countries outside India, and the latter, 31,898 such doses. The increase of the indents from India (outside the Punjab) is therefore represented by the difference of 141,228 doses of the present year, as compared to 75,754 of the year before the Malkowal occurrence, both figures referring to the first nine months of each working year.

(D.)

The inoculation reaction from certain modifications of the prophylactic used in the Punjab and elsewhere has been found to be much milder than that from the ordinary material, while the protection derived from it was satisfactory. In a number of places this was observed and reported in a general form only; in others very minute enquiries were made. Among the first the following may be quoted.

Letter from Major J. B. Jameson, M.B., I.M.S., Medical Officer in charge, West Hospital, Rájkot, to the Superintendent, Plague Research Laboratory, dated the 20th November 1902.

"With reference to your letter No. 3852, dated 7th instant, I have the honour to state that no records of temperatures were kept, as owing to stress of work and shortness of hands it was impossible to keep the inoculated under observation.

As to the *Famine Orphan Asylum* I had all the orphans numbering 185 inoculated, as they were living in the neighbourhood of plague, and many dead rats were found in their houses. The boys were not removed from their surroundings after being inoculated, in spite of several appeals from civilians to remove them. Only one case of plague occurred among them, and he recovered, his case being a mild one and his bubo subsiding, showing, I think, the efficacy of the serum. No other case occurred, and the boys are still living in the same quarters. The only precaution taken when the case of plague occurred was to segregate the orphans *en bloc* for 10 days. I may mention that after inoculation no case of high fever occurred, most of them having a mild touch.

I may also quote the case of the *Hospital servants* here. We had one case of plague in the compound, *viz.*, the cook's servant, followed by two others, the Baniah and the Baniah's brother, the two latter going to and from the infected town daily for supplies. After the first case occurred some of the Hospital servants were inoculated, and one case of plague occurred in an inoculated servant, this case being of very mild type, the bubo in this case requiring incision, but his fever and other symptoms being unusually mild.

The *State Jail* prisoners, 65, were all inoculated excepting 1. No case of plague occurred in the Jail. After inoculation the fever was very slight."

Letter from Lieutenant-Colonel K. A. Dalal, M.B., I.M.S., Civil Surgeon, Dhulia, to the Superintendent, Plague Research Laboratory, Bombay, dated the 7th December 1902.

"Having read in the *Times of India* about the calamity in the Punjab consequent upon inoculation, and suspension of inoculation for a short time, I have the honour to request that you will be pleased to inform me whether I should use the serum supplied, in Box No. 441, number of doses 251, and dosage 2 and 2·3 c.c., on the 22nd November 1902.

I have already used 2,500 doses, with very great success, of the serum received in September last."

Letter from Lieutenant-Colonel K. A. Dalal, M.B., I.M.S., Civil Surgeon, Dhulia, to the Superintendent, Plague Research Laboratory, Bombay, dated the 12th December 1902.

"With reference to your letter No. 4231, dated the 6th December 1902, I have the honour to state the following information:—

1. Box No. 1 containing 500 doses of concentrated prophylactic serum was received on the 11th September 1902 and returned, after using it, to your Laboratory, on the 24th September 1902. (*Vide* your office memorandum No. 3374, dated the 27th September 1902.)

2. Box No. 2 containing 503 doses of concentrated prophylactic serum was received on the 6th October 1902 and returned, after using it, to your Laboratory, on the 5th December 1902. (*Vide* your office memorandum No. 4242, dated the 8th December 1902.)

3. I have already used 3,000 doses, including 1,003 doses of concentrated prophylactic serum, with very good success. The concentrated prophylactic serum was mostly used on prisoners, although a few persons of the town were also inoculated with the same serum; and I observed no ill effects from it."

Letter from Dr. A. G. Mowat, M.B., C.M. (Glas.), to Major W. B. Bannerman, I.M.S., Superintendent, Plague Research Laboratory, Bombay, dated Jalna, the 19th January 1903.

"I had left Lanowli before your letter arrived. Had it been a week or two later I might have given you the results of the village work, but the case of our Jalna people is striking.

Plague broke out in Jalna in the middle of October 1902, but was only declared as such at the end of that month. I happened to be in Bombay at the time and visited the Plague Research Laboratory, Parel, where you showed me the process of manufacture of the prophylactic and instructed me in the method of inoculation.

On my return home I began inoculating (*i. e.*, on October 30th) our Christian people of whom there are some 300 living in Jalna: 31 of these lived in Kaderabad (a part of Jalna where plague appeared first) and 150 are in our boarding schools.

Before my arrival from Bombay one of our people living in Kaderabad had been stricken, so I inoculated the remaining 30 as they lived in the same *wada*. After inoculation they continued to live in their *wada*, although the above case was *not* removed. In this *wada* about 100 Hindus reside, one of whom was inoculated. Plague increased and one of our inoculated Christians was stricken, but recovered. For a few days she was delirious, a bubo formed, but she recovered. Those in attendance on these two cases did not sicken. When this second case occurred I got the Christians to vacate their houses; but they were constantly going into the town for the sake of work. *None* of them however has been stricken and no deaths occurred. Of the 100 Hindus in the same *wada* 17 were stricken and 9 died. In the Cantonment, of the 120 Christians all of whom were inoculated, *two* were stricken and both died. These were boys who had been playing with a dead squirrel. It should be noted in this case that on account of dead rats having been found in the houses of six different families, all (19 persons) were housed in our school-house, a building with central hall and 4 class rooms on either side. These 19 persons were in constant contact with one another. When the two boys sickened, the others except parents and sister left the building. The parents nursed the boys. *None* of the 17 persons were affected: and there has been no case amongst the remainder of our people.

A dead rat and squirrel were found in our girls' boarding school: but the rooms were disinfected and the girls continued to occupy the other rooms. None have been stricken. The boys vacated their rooms and there have been no cases amongst them.

So that we have had *three* (3) attacks and 2 deaths amongst our 300 Christians at Jalna.

It should be noted that over 2,500 have died at Jalna out of a population of some 35,000. It has been remarked upon by Hindus that the Christians have escaped as none others have.

Besides Christians, I inoculated a number of Hindus at Jalna: these are now scattered: but of those we have been able to trace *none* have been stricken.

At Bethel, a Christian village, 3 miles off, we have a population of 182. Some 175 of these were inoculated, as plague was prevalent in all surrounding villages. One boy who had been inoculated ate a diseased fowl, sickened and died. I saw him and thought it a case that would recover, but he was not properly cared for and died. Another case occurred there: this was one of those who had not been inoculated. He recovered! Still I believe that inoculation protected our Bethel people and was the means of staying the progress of plague. I have inoculated 1,694 persons many of whom live in the surrounding villages where plague is still raging: and only know of 3 cases that died and a fourth that

recovered from amongst that number. I have noticed no ill effect from the use of the prophylactic. No abscesses have formed (though in one or two cases there was considerable swelling of the arm) and with few exceptions the temperature did not rise above 101·5°—102°. Slight sickness, headache and fever complained of passed away in a day or two. So that I consider that the prophylactic is a *safe remedy* and believe that its protective powers are considerable."

Letter from Lieutenant-Colonel H. G. L. Wortabet, I.M.S., to the Superintendent, Plague Research Laboratory, Bombay, dated Aurangabad (Deccan), the 1st August 1903.

"The Revd. W. C. Whiteside, Church Missionary Society, has asked me to write and request you to kindly send him about 250 doses of Mr. Haffkine's Plague Prophylactic for his school, posting to him the bill.

It may interest you to learn that Mr. Whiteside's establishment consisting of some two or three hundred children were inoculated at the commencement of the last plague epidemic at this station, and that of this number only 4 developed plague, but recovered.

Please address the parcel to him."

Among the *detailed* observations collected on the subject the following may be quoted.

Letter from Dr. F. Lindsay Dickson, Phagwara (Punjab), to W. M. Haffkine, Esquire, C. I. E., Director-in-Chief, Plague Research Laboratory, Bombay, dated the 24th January 1903.

"In reply to yours of 18th January 1903, I beg to enclose list of cases of plague which occurred in those inoculated with the 'small dose' brew. Up to date no cases of plague have occurred among those inoculated by me with the other brews (about 7,000)."

References to attacks among Inoculated persons.

Serial Number in Register.	Names.	Father's or husband's name.	Number of Brew.	Dose c.c.	Attacked with Plague.	Recovered or died.	Remarks.
4741	Ram Rakhi ...	Devi Das ..	8850	2	Attacked, bubonic plague, 2nd November 1902.	Recovered.	
4825	Dewa Singh ...	Boon Singh ...	69	⅘	Attacked, bubonic plague, 27th October 1902.	Do.	
4948	Lal Dai ...	Jagannath ...	69	⅘	Attacked, bubonic plague, 5th November 1902.	Do.	
4964	Maya Vanti ...	Ram Rakha ...	69	⅘	Attacked, bubonic plague, 6th November 1902.	Do.	
5047	Gunna ...	Bela Singh ...	69	⅖	Convalescent, 18th November 1902, colic (?) and difficult labour.	Died ...	After 8 days' fever she died before child was born, said to have been 9 months' pregnant.
5049	Ishri ...	Bachan Singh .	69	⅘	Attacked, bubonic plague, 14th November 1902.	Recovered.	
5153	Khero ...	Koda ...	69	1	Attacked, bubonic plague, 1st January 1903.	Do.	
5188	Santi ...	Ganga Sing ...	169	⅕	Attacked, bubonic plague, 9th January 1903.	Died 10th January 1903.	
5201	Umri ...	Roora ...	169	⅘	Attacked, bubonic plague, 5th January 1903.	Recovered.	
5254	Nizam ...	Shadi ...	169	1	Attacked, bubonic plague, 1st January 1903.	Do.	
5275	Ishar ...	Kaisar ...	65	1	Attacked (Fever and cough), 6th December 1902.	Died.	
5280	Akki ...	Chetu ...	65	⅗	Attacked (Fever and cough), 9th January 1903.	Recovered.	
5297	Achhri ...	Shaman ...	65	⅘	Attacked (Fever and cough), 6th January 1903.	Died.	
5316	Hako ...	Ghanda Singh .	65	1	Attacked (Fever and cough), 6th December 1902.	Recovered.	
5329	Dula ...	Ganga Ram ...	65	⅘	Attacked (Fever and cough), 5th November 1902.	Do.	
5420	Chandi ...	Ishar Singh ...	68	⅘	Attacked (Fever and cough), 18th November 1902.	Do.	

Serial Number in Register.	Names.	Father's or husband's name.	Number of Brew.	Dose c.c.	Attacked with Plague.	Recovered or died.	Remarks.
5437	Bhali ...	Narain Singh .	68	$\frac{1}{5}$	Attacked (Fever and cough), 14th November 1902.	Died.	
5421	Labhu ...	Harjas ...	63	$\frac{1}{4}$	Attacked (Fever and cough), 18th November 1902.	Recovered.	
5465	Gangi ...	Jai Singh ...	68	$\frac{3}{5}$	Attacked (Fever and cough), 17th November 1902.	Do.	
5468	Gurdit Singh ...	GurmukhSingh	68	$\frac{4}{5}$	Attacked (Fever and cough), 18th November 1902.	Died.	
5513	Tharki ...	Mana Singh ...	68	$\frac{4}{5}$	Attacked (Fever and cough), 9th November 1902.	Recovered.	
5537	Jhanda ...	Kheva ...	68	$\frac{1}{2}$	Attacked (Fever and cough), 9th January 1903.	Do.	
5563	Khemi ...	Ramjas ...	68	$\frac{3}{5}$	Attacked (Fever and cough), 15th December 1902.	Died on the same day.	
5570	Tatto ...	Hira	68	$\frac{4}{5}$	Attacked (Fever and cough), 24th December 1902.	Died on 28th December 1902.	
5605	Bhagwani ...	Ramjas ...	68	$\frac{4}{5}$	Attacked (Fever and cough), 15th December 1902.	Died on 18th December 1902.	
					Total ...	9	Deaths.

Observation by Dr. F. M. Gibson, M.B., B.Sc., of the Plague Research Laboratory, Bombay, on the brews used in the above Inoculations.

"No. 8850 of the first brew on the list refers to an old standard (not concentrated) prophylactic brew, and was dosed at 7·5 c.c. It would therefore seem that the person to whom this was administered is a young child. No. 169 is also an old standard brew prepared in October last, with dosage fixed at 7·5 c.c. Of this brew $\frac{1}{5}$ to 1 c.c. only has been given. There is possibly a mistake in quoting the number of the brew. Probably 1,69 was intended.

The other brews, if correctly described, are transferred agar-broth (concentrated) brews, prepared in September last, and are dosed at 1 c.c. Only 3 of the 21 persons inoculated with these brews were given the full prescribed dose, the rest received reduced doses, possibly on account of these being women or children. The case mortality in the attacked was 38 per cent. and if we exclude the fatal case complicated with child birth, it comes to 35 per cent., *i.e.*, a reduction of approximately 50 per cent. of the ordinary case mortality."

VILLAGE OF DAYALPUR, PUNJAB.

Census forwarded to the Laboratory on 14th April 1903 by Dr. F. Lindsay Dickson, Inoculating Officer, Punjab.

Total of	Number of cases.	Number of deaths.	Case mortality.
Uninoculated 93 ...	60	38	63·3 per cent.
Inoculated 138 ...	29	10	34·5 ,,
	Total mortality	reduced by ...	82·1 ,,

Details of the Plague census of Dayalpur village.

Received with Dr. Dickson's letter of 14th April 1903.

	Members of the family.	Sex.	Age.	Inoculated.	Number of Brew.	Dose.	Attacked by plague. Recovery.	Attacked by plague. Deaths.	Remarks.
Budhu ...	Budhu ...	M.	60	Yes ...	6959	1¾ c.c.	.....	...	
	Munshi ...	M.	40	Yes ...	6914	4 c.c.	.....	...	
	Bujha ...	M.	10	Yes ...	6914	3 c.c.	.....	...	
	Bhani ...	F.	22	Yes ...	6959	2 c.c.	.....	...	
Ganga ...	Ganga ...	M.	60	Yes ...	6959	1½ c.c.	.....	...	
	Devi Chand ...	M.	6	Yes ...	...	...	.....	...	
Jawahar Singh ...	Jawahar Singh ...	M.	65	Nil ...	...	...	.....	...	
	Gurbakhsh ...	M.	12	Yes ...	6959	1¼ c.c.	.....	...	
	Ram Bakhsh ...	M.	7	Yes ...	...	1 c.c.	.....	...	
Bhaia Singh ...	Bhaia Singh ...	M.	50	Nil ...	...	...	.....	...	
	Gangi ...	F.	45	Yes ...	6959	2 c.c.	.....	...	
	Dalipa ...	M.	10	Yes ...	6959	1½ c.c.	Recovered	...	Attacked by plague and recovered.
	Kandu ...	M.	13	Yes ...	...	...	.....	...	
	Bhavi ...	F.	8	Yes ...	...	...	.....	..	
	Devi Ditta ...	M.	6	Yes ...	6959	2¼ c.c.	.....	...	
Labhu ...	Labhu ...	M.	30	Yes ...	6959	2 c.c.	.....	...	
	Chando ...	F.	60	Yes ...	6959	2 c.c.	.....	...	
	Rajo ...	F.	25	Yes ...	6959	2 c.c.	.....	...	
	Peremi ...	F.	15	Nil ...	...	...	.....	...	
	Parmeshri ...	F.	13	Nil ...	...	...	.....	...	
	Chinti ...	F.	4	Nil ...	...	...	.....	...	
Alla Singh ...	Alla Singh ...	M.	40	Nil ...	...	...	.....	...	Attacked by B. plague.
Vazira ...	Vazira ...	M.	62	Nil ...	...	...	.....	...	
	Milkhi ...	M.	35	Yes ...	6959	2½ c.c.	.....	...	
	Mathro ...	F.	27	Nil. ...	...	...	.....	Died ...	Got plague and died.
Sundar ...	Sundar ...	M.	40	Nil ...	...	...	.....	...	
	Jai Kaur ...	M.	32	Yes ...	6959	2 c.c.	.....	...	
	Tulsi ...	M.	10	Yes ...	6959	1½ c.c.	.....	...	
Dasondhi ...	Dasondhi ...	M.	70	Yes ...	6959	2 c.c.	.....	...	
	Mahar Singh ...	M.	45	Yes ...	6959	1½ c.c.	.....	...	
	Rala ...	M.	60	Yes ...	6959	1½ c.c.	.....	...	
	Sahib Ditta ...	M.	30	Yes ...	6959	2 c.c.	.....	...	
	Rolu ...	M.	20	Yes ...	6959	1¾ c.c.	.....	...	
	Kartara ...	M.	10	Yes ...	6959	1½ c.c.	.....	...	
	Santa ...	M.	8	Yes ...	6959	1½ c.c.	.....	...	
	Santi ...	M.	11	Yes ...	6959	1½ c.c.	.....	...	
	Indi ...	F.	30	Nil ...	...	...	.....	Died ...	Got plague and died.
	Vanti ...	F.	4	Nil ...	...	...	.....	Died ...	Do.
Hira Singh ...	Hira Singh ...	M.	55	Nil ...	...	...	.....	...	
	Malan ...	F.	45	Yes ...	6959	2 c.c.	.....	...	
	Dalipa ...	M.	18	Yes ...	6959	1¾ c.c.	.....	...	
	Vanta ...	M.	10	Yes ...	6959	1½ c.c.	.....	...	
	Chinti ...	F.	7	Yes ...	6959	1½ c.c.	.....	...	
	Banti ...	F.	8	Yes ...	6959	1½ c.c.	.....	...	
Kirpa ...	Kirpa ...	M.	25	Yes ...	6959	2 c.c.	.....	...	
	Gajju ...	M.	12	Yes ...	6959	2 c.c.	.....	...	
	Radhi ...	F.	12	Yes ...	6959	1½ c.c.	.....	...	
Ishar Singh ...	Ishar Singh ...	M.	45	Yes ...	6959	2 c.c.	.....	...	
	Gurditta ...	M.	20	Yes ...	6959	2 c.c.	.....	...	
	Nikka ...	M.	15	Nil ...	...	...	.....	Died ...	Attacked and died.
	Kishni ...	F.	10	Yes ...	6959	1½ c.c.	.....	...	
	Vanti ...	F.	8	Nil ...	...	...	.....	Died ...	Attacked and died.
	Samaukour ...	F.	6	Nil ...	...	...	.....	Died ..	Do.
Dalel Singh ...	Dalel Singh ...	M.	30	Yes ...	6959	2½ c.c.	Recovered	...	Attacked by plague and recovered.
	Milkhi ...	M.	25	Yes ...	6959	2 c.c.	.....	...	
	Puremi ...	F.	28	Nil ...	...	...	.....	Died ...	Attacked and died.
	Dhanti ...	F.	7	Nil ...	...	...	.....	...	
	Hukmi ...	F.	5	Nil ...	...	...	.....	...	
Sundar Singh ...	Sundar Singh ...	M.	55	Yes ...	6959	2 c.c.	.....	...	
	Man Singh ...	M.	50	Yes ...	6959	2 c.c.	Recovered	...	Attacked and recovered.
	Indar Singh ...	M.	44	Yes ...	6959	2½ c.c.	.....	...	
	Dhanno ...	F.	40	Yes ...	6959	2 c.c.	.....	...	
	Partapi ...	F.	35	Nil ...	...	...	.....	Died ...	Attacked and died.
	Jiwi ...	F.	68	Yes ...	6959	1½ c.c.	Recovered	...	Attacked and recovered.
Ganga ...	Ganga ...	M.	50	Yes ...	6959	2 c.c.	.....	...	
	Jawali ...	F.	45	Nil ...	...	...	.....	...	
	Uttam Dai ...	F.	15	Yes ...	6959	1¾ c.c.	.....	...	

	Members of the family.	Sex.	Age.	Inoculated.	Number of Brew.	Dose.	Attacked by plague. Recovery.	Attacked by plague. Deaths.	Remarks.
Khushal Singh ...	Khushal Singh ...	M.	40	Yes ...	6959	2 c.c.	Recovered	...	Attacked and recovered.
	Nihal Singh ...	M.	45	Yes ..	6959	2 c.c.	.....	...	
	Gurdit Singh ...	M.	20	Yes ...	6959	2 c.c.	.....	...	
	Nikka ...	M.	12	Yes ...	6959	1½ c.c.	.....	...	
	Atri ...	F.	40	Yes ...	6959	1½ c.c.	.....	...	
Khushal Singh ...	Khushal Singh ...	M.	48	Yes ...	6959	2¼ c.c.	Recovered	...	Attacked and recovered.
	Nihal Singh ...	M.	40	Yes ...	6959	2 c.c.	.....	...	
	Atri ...	F.	40	Yes ...	6959	1½ c.c.	.....	...	
Bhala ...	Bhala ..	M.	45	Nil ...	...	...	Recovered	...	Got plague and recovered.
	Munshi ...	M.	22	Nil ...	...	..	.....	...	
	Karam Chand ..	M.	7	Yes ...	6959	2 c.c.	Recovered	...	Got plague and recovered.
	Muhar Chand ..	M.	6	Yes ...	6959	2 c.c.	Recovered	...	Do.
	Basanti ...	F.	11	Nil ...	...	...	.....	Died ...	Got plague and died.
Lal Singh ...	Lal Singh ...	M.	45	Yes ..	6959	2½ c.c.	.....	...	
	Basanti ...	F.	8	Nil ...	...	...	.....	Died ...	With plague.
	Dalipa ...	M.	5	Yes ...	6959	1 c.c.	.....	...	
Bhagwan Sing ...	Bhagwan Sing ...	M.	80	Nil ...	...	...	.....	...	
	Lakha Sing ...	M.	30	Yes ...	6959	2 c.c.	Recovered ...	...	Got plague and recovered.
	Gulabdai ...	F.	75	Yes ...	6959	1½ c.c.	... ..	Died ...	Got plague and died.
	Parsinni ...	F.	12	Yes ...	6959	1½ c.c.	.....	...	
	Jawala ...	M.	8	Yes ...	6959	1½ c.c.	.....	...	
	Hazara ..	M.	2	Yes ...	6959	1 c.c.	.....	...	
Lata Singh ...	Lata Singh ...	M.	40	Yes ...	6959	2 c.c.	.....	...	
	Bhavi ...	F.	6	Yes ...	6959	1½ c.c.	.....	Died ...	With plague.
	Dhanvi ...	F.	8	Nil ...	...	...	.....	...	
	Vanti ...	F.	5	Nil ...	...	...	.....	...	
	Sahban ...	F.	75	Yes ...	6959	1¾ c.c.	.....	...	
	Chandi ...	F.	24	Yes ...	6959	2 c.c.	.....	...	
	Bachinta ...	M.	7	Nil ...	...	...	Recovered ...	...	Got plague and recovered.
Waryam Singh ...	Waryam ...	M.	40	Yes ...	6959	2 c.c.	.....	...	
	Mano ...	F.	49	Yes ...	6959	2 c.c.	Recovered ...	...	Got plague and recovered.
	Ramchand ...	M.	40	Yes ...	6959	2 c.c.	.....	...	
	Nihalkour ...	F.	33	Yes ...	6959	2 c.c.	.....	...	
	Jawali ...	F.	20	Yes ...	6959	2 c.c.	.....	...	
	Ganeshi ...	F.	15	Yes ...	6959	1¾ c.c.	Recovered ...	...	Got plague and recovered.
	Labhu ...	M.	22	Yes ...	6959	2 c.c.	.....	...	
Labh Singh ...	Labh Singh ...	M.	30	Yes ...	6959	2¼ c.c.	.....	...	
	Rajji ...	F.	70	Nil ...	...	...	.....	...	
	Jai Kour ...	F.	24	Nil ...	...	...	Recovered	...	Got plague and recovered.
Gurditta ...	Gurditta ...	M.	16	Yes ...	6959	2 c.c.	.....	...	
	Rao ...	F.	20	Nil ...	...	...	Recovered ...	...	Got plague and recovered.
	Partapi ...	F.	25	Nil ...	...	...	.....	...	Do.
	Jawala ...	M.	12	Yes ...	6959	1½ c.c.	.....	...	
	Basanta ...	M.	8	Yes ...	6959	1½ c.c.	.. ...	...	
Moti ...	Moti ...	M.	40	Nil ...	...	...	.....	...	
	Dharman ...	F.	35	Yes ...	6959	2 c.c.	Recovered ...	...	Got plague and recovered.
	Santa ...	M.	8	Yes ...	6959	1 c.c.	.....	...	
	Mahan ...	F.	15	Yes ...	6959	2 c.c.	.....	...	
	Vanti ...	F.	2	Yes ...	6959	1 c.c.	.....	...	
Mali ...	Mali ...	M.	30	Yes ...	6959	2 c.c.	.....	...	
	Rajmal ...	M.	25	Yes ...	6959	2 c.c.	... ..	...	
	Nama ...	M.	18	Yes ...	6959	1¾ c.c.	.....	...	
	Atri ...	F.	45	Yes ...	6959	2 c.c.	.....	...	
Nihala ...	Nihala ...	M.	65	Yes ...	6959	2 c.c.	.....	...	
	Jiwi ..	F.	55	Nil ...	...	...	Recovered ...	...	Got plague and recovered.
	Nathu ...	F.	35	Yes ...	6959	2½ c.c.	.....	...	
	Raj Kour ...	F.	30	Yes ...	6959	2¼ c.c.	.....	...	
	Indi ...	F.	9	Yes ...	6959	1½ c.c.	.....	Died ...	With plague.
Buta ...	Buta ...	M.	55	Nil ...	...	...	.....	...	
	Jamait ...	M.	16	Yes ...	6959	1¾ c.c.	... ..	...	
	Munni ..	F.	26	Yes ...	6959	2 c.c.	Recovered ...	...	Got plague and recovered.
	Raj Kour ...	F.	30	Yes ...	6959	2 c.c.	... ..	...	
	Hazara ...	M.	18	Yes ...	6959	2 c.c.	.....	...	
	Kurtara ...	M.	15	Yes ...	6959	1¾ c.c.	.....	...	
Nahara ...	Nahara ...	M.	52	Nil ...	...	...	.....	...	
	Gurditta ...	M.	12	Nil ...	...	...	Recovered	...	Got plague and recovered.
Ram Kishan ...	Ram Kishan ...	M.	35	Yes ...	6959	2¼ c.c.	.....	...	
	Khizana ...	M.	22	Nil ...	...	...	... ..	Died ...	With plague.
	Achhro ...	F.	30	Nil ...	...	...	.....	Died ...	Do.
	Tabo ...	F.	65	Yes ...	6959	2 c.c.	.....	...	

	Members of the family.	Sex.	Age.	Inoculated.	Number of Brew.	Dose.	Attacked by plague.		Remarks.
							Recovery.	Deaths.	
Kahan Singh ...	Kahan Singh ...	M.	45	Yes ...	6914	4 c.c.	.....	...	
	Arjan Singh ...	M.	32	Yes ...	6914	4½ c.c.	.....	...	
	Ghandila ...	M.	20	Nil ...	...	...	.....	Died ...	With plague.
	Jiwi ...	F.	35	Nil ...	...	...	.....	Died ...	Do.
	Partapi ...	F.	30	Yes ...	6914	4 c.c.	.....	...	
Sher Singh ...	Sher Singh ...	M.	45	Yes ...	6959	2 c.c.	.....	...	
	Beli ...	M.	40	Yes ...	6959	2 c.c.	.....	...	
	Hazara Singh ...	M.	25	Yes ...	6959	2 c.c.	Recovered ...	...	Got plague and recovered.
	Bujha ...	M.	20	Yes ...	6914	4 c.c.	.....	...	
	Rali ...	F.	8	Nil ...	...	...	.....	Died ...	With plague.
	Bhulla ...	M.	10	Nil ...	...	...	.....	Died ...	Do.
	Birchand ...	M.	18	Nil ...	...	...	.....	Died ...	Do.
	Kishan Dai ...	F.	30	Nil ...	...	...	.....	Died ...	Do.
Charna ...	Charna ...	M.	28	Nil ...	...	...	.....	...	
	Nami ...	F.	25	Nil ...	...	...	Recovered ...	...	Got plague and recovered.
Harnam Singh ...	Harnam Singh ...	M.	30	Yes ...	6959	2½ c.c.	.....	...	
	Bholi ...	F.	15	Yes ...	6959	1½ c.c.	.....	...	
	Dhanno ...	F.	10	Yes ...	6959	1¼ c.c.	.....	...	
Hira ...	Hira ...	M.	60	Nil ...	...	...	Recovered ...	...	Got plague and recovered.
	Rajmal ...	M.	24	Nil ...	...	...	Recovered ...	...	Do.
	Bhagmal ...	M.	18	Yes ...	6959	1¾ c.c.	Recovered ...	...	Do.
	Ramchand ...	M.	12	Yes ...	6959	1½ c.c.	Recovered ...	...	Do.
	Sheru ...	M.	40	Nil ...	...	...	Recovered ...	...	Do.
	Bhola ...	M.	25	Yes ...	6959	2 c.c.	Recovered ...	...	Do.
Badhawa ...	Badhawa ...	M.	25	Yes ...	6914	4½ c.c.	.....	...	
	Uttam ...	M.	12	Nil ...	...	...	.....	...	
	Paman ...	M.	8	Nil ...	...	...	Recovered ...	...	Got plague and recovered.
	Sahib Dai ...	M.	45	Nil ...	...	...	Recovered ...	...	Do.
Chhajju ...	Chhajju ...	M.	50	Nil ...	...	...	.....	Died ...	With plague.
Begi ...	Begi ...	F.	45	Nil ...	...	...	.....	...	
	Rodi ...	F.	12	Yes ...	6959	1½ c.c.	.....	...	
	Barkat ...	F.	22	Yes ...	6959	1¾ c.c.	Recovered ...	...	Got plague and recovered.
Pir Bon ...	Pir Bon ...	M.	35	Yes ...	6959	2½ c.c.	Recovered ...	...	Got plague and recovered.
Maya ...	Maya ...	M.	40	Yes ...	6959	1 c.c.	.....	...	
	Labhu ...	M.	20	Nil ...	...	...	.....	...	
	Rajo ...	F.	40	Yes ...	6959	2 c.c.	.....	Died ...	With plague.
Gojar ...	Gojar ...	M.	24	Nil ...	...	...	.....	...	
	Dogar ...	M.	28	Nil ...	...	...	.....	...	
	Puran ...	M.	35	Nil ...	...	...	Recovered ...	...	Got plague and recovered.
Kunnun ...	Kunnun ...	M.	40	Nil ...	...	...	.....	...	
	Rala ...	M.	45	Yes ...	6959	2 c.c.	.....	Died ...	With plague.
Ishar ...	Ishar ...	M.	35	Nil ...	...	...	.....	Died ...	With plague.
	Basant Singh ...	M.	30	Nil ...	...	...	.....	Died ...	Do.
	Mano ...	M.	30	Nil ...	...	...	.....	Died ...	Do.
	Achhro ...	F.	55	Nil ...	...	...	.....	Died ...	Do.
	Hazara ...	M.	8	Yes ...	6959	1½ c.c.	.....	...	
	Kartara ...	M.	10	Yes ...	6959	1½ c.c.	.....	...	
	Paremi ...	F.	10	Nil ...	...	...	.....	Died ...	With plague.
Partap singh ...	Partap Singh ...	M.	40	Yes ...	6959	2 c.c.	.....	...	
	Gabi ...	F.	32	Nil ...	...	...	.....	Died ...	With plague.
Bhulla ...	Bhulla ...	M.	30	Yes ...	6959	2 c.c.	.....	...	
	Baj ...	M.	25	Yes ...	6959	2 c.c.	.....	...	
	Gango ...	M.	40	Yes ...	6959	2 c.c.	.....	Died ...	With plague.
	Nanda ...	F.	3	Nil ...	...	...	.....	Died ...	Do.
	Atu ...	M.	1	Nil ...	...	...	.....	Died ...	Do.
Labhu ...	Labhu ...	M.	25	Yes ...	6959	2 c.c.	.....	...	
	Mugha ...	M.	18	Yes ...	6959	2 c.c.	.....	...	
Dulip Singh ...	Dulip Singh ...	M.	30	Yes ...	6959	2 c.c.	.....	...	
	Karmi ...	F.	22	Nil ...	...	...	.....	Died ...	With plague.
Mela ...	Mela ...	M.	40	Nil ...	...	...	.....	Died ...	With plague.
	Jawala ...	M.	18	Yes ...	6959	1¾ c.c.	.....	...	
Rala ...	Fagiria ...	M.	8	Nil ...	...	...	Recovered ...	...	Got plague and recovered.
	Indan ...	F.	60	Nil ...	...	...	.....	Died ...	With plague.
Ram Ditta ...	Ram Ditta ...	M.	55	Nil ...	...	...	Recovered ...	...	Got plague and recovered.
Ghaya ...	Ghaya ...	M.	55	Nil ...	...	...	.....	Died ...	With plague.
Dewa ...	Dewa ...	M.	55	Nil ...	...	...	.....	Died ...	With plague.
	Sundar ...	M.	30	Nil ...	...	...	Recovered ...	...	Got plague and recovered.

	Members of the family.	Sex.	Age.	Inoculated.	No. of Brew.	Dose.	Attacked by Plague.		Remarks.
							Recovery.	Deaths.	
Pheru ...	Pheru ...	M.	35	Nil ...	...	...	.....	...	
	Parlapi ...	F.	30	Nil ...	...	...	.....	Died ...	With plague.
Jiwi ...	Jiwi ...	F.	40	Nil ...	...	...	.....	Died ...	With plague.
	Narain Singh ...	M.	40	Nil ...	...	...	.....	...	
	Jawali ...	F.	13	Nil ...	...	...	.....	...	
Teja Singh ...	Teja Singh ...	M.	45	Nil ...	...	...	.....	...	
	Gurditta ...	M.	19	Nil ...	...	...	Recovered ..	...	Got plague and recovered.
	Hazara ...	M.	12	Nil ...	...	...	Recovered ...	...	Do.
	Gulzara ...	M.	4	Nil ...	...	...	.....	Died ...	With plague.
	Mutab Kour ...	F.	20	Nil ...	...	...	Recovered ...	...	Got plague and recovered.
Fatta ...	Fatta ...	M.	45	Nil ...	...	...	.....	...	
	Ishari ...	F.	12	Yes ...	...	...	.....	Died ...	With plague.
Gonda Das ...	Gonda Das ...	M.	40	Nil ...	...	...	.....	...	
	Vanti ...	M.	5	Nil ...	...	...	.....	Died ...	With plague.
Gulab Singh ...	Gulab Singh ...	M.	50	Nil ...	...	...	.....	...	
	Sundar ...	M.	19	Nil ...	...	...	Recovered...	...	Got plague and recovered.
Ralu ...	Ralu ...	M.	35	Yes ...	6959	2½ c.c.	.....	...	
	Dayali ...	F.	30	Yes ...	6959	2 c.c.	.....	...	
	Chando ...	F.	13	Yes ...	6959	1½ c.c.	.....	Died ...	With plague.
	Bindo ...	F.	9	Nil ...	...	...	.....	Died ...	Do.
Kaka ...	Ruldan ...	F.	50	Yes ...	6959	1¾ c.c.	.....	Died ...	With plague.
	Rulia ...	M.	11	Nil ...	...	...	.....	Died ...	Do.
Rugga ...	Rugga ...	M.	65	Yes ...	6959	2 c.c.	.....	...	
	Mango ...	F.	18	Yes ...	6959	1½ c.c.	.....	Died ...	With plague.
	Malan ...	F.	25	Yes ...	6959	2 c.c.	.....	...	
	Nama ...	M.	5	Yes ...	6959	1 c.c	.....	...	
Mala Singh ...	Mala Singh ...	M.	40	Yes ...	6959	2 c.c.	.....	...	

F. L. DICKSON,
Plague Medical Officer, Jullandur District,
Camp Bilga.

Dated 13th of April 1903.

In the winter of 1902-03 about half a million people were inoculated in the Punjab, partly with the modified form of prophylactic, but mainly with the ordinary material. The total incidence of plague deaths among those inoculated was, during the very severe epidemic of that winter, under a ¼ per cent., while the proportion of deaths to attacks was under 25 per cent. These figures represent a very considerable reduction as compared with the incidence of attacks and deaths that occurred in the non-inoculated.

(E.)

In addition to the countries mentioned on page 17 of the Report for 1896—1902, the Bombay Plague Prophylactic is now manufactured, for use in plague-stricken localities, also in France, Belgium and Japan.

During the period under review the vast demands for the plague prophylactic put an extraordinary heavy strain on the Laboratory, and hardly any attention could be devoted to work in other directions, whether in connection with plague or otherwise. In the subjoined lines a brief sketch, however, is given of what we were able to do outside our main duties.

(2).—DISINFECTION AND STERILIZATION.

No systematic studies on these subjects were carried out in accordance with Government of India's wishes.

Upon the application from the Government of the Punjab, the sterilising properties of Mr. Sawnhey's dessicator were, however, studied and the results communicated to you with this office letter No. 3832 of 5th November 1902. In the Bombay climate it appeared that the highest temperature recorded in a closed room, in which a full charge of fuel was burnt in the dessicator, was 87° C., and in various places of the room non spore-bearing microbes retained their vitality notwithstanding several hours of heating.

(3).—EXAMINATION OF PLAGUE SUSPECTED ANIMALS, &c.

In April and May 1903, there occurred a severe epidemic among the animals of the Victoria Gardens in Bombay. It was suspected that it might be plague, and a number of the dead animals, deer, kangaroos, rabbits, guinea-pigs, monkeys, various species of birds, were sent to the Laboratory for examination. In none, however, excepting the guinea-pigs, was plague detected. The guinea-pigs had a general epidemic among them. In one goat, plague-like bacilli were seen, but their authentic nature was not confirmed.

198 examinations of rats were recorded (106 of rats alive, and 92 dead); in 33 cases plague infection was detected. Most of the rats were sent in in September to January inclusive, and were gathered in Wards A, B, F and G of the city.

The results of these examinations were taken into account in connection with the evacuation or otherwise of the quarters in which the rats were caught or found dead.

(4).—PATHOLOGICAL STUDIES.

In connection with the study of the effect of various curative sera for plague, samples of blood from a large number of plague patients were examined by Captain E. D. W. Greig, I. M. S., and Drs. Costello and W. G. West. By injecting the samples into rats it was found that as many as 60 per cent. of the so-called bubonic cases (in contradistinction to scepticaemic, non-bubonic ones) had, on admission to hospital, already plague bacilli in their blood circulation. These cases were almost all fatal, though, in many of them, death occurred only several days after their circulation got infected. The cases in which microbes were not discoverable in the peripheral blood on the day of admission gave a mortality about half that of the others.

(5).—RESEARCHES ON THE PLAGUE BACILLUS IN NATURE, OUTSIDE THE HUMAN AND ANIMAL BODY.

On the constitution of the so-called "Plague Research Committee" in Bombay, in October 1896, I suggested to two of my fellow members on it, *viz.*, Mr. E. H. Hankin, M.A., whose share of investigation it was to search for the plague bacillus in nature, and Dr. N. F. Surveyor, who was to study the epidemic in rats, to investigate the possibility of the transmission of plague by suctorial insects, *viz.*, by fleas and bugs. The "circumstantial evidence" which led me to this suggestion was that the plague in Bombay had remained for a considerable time restricted to certain houses in Mándvi whose inhabitants were workers in other parts of the town, *viz.*, in the docks and elsewhere, and that of the various races and castes, the Jains, at that time, were mostly affected. The circumstances referred to seemed to show that the people were not favourable carriers and disseminators of infection; that the plague was not carried by water—as cholera is,—for the affected houses had the same supply as many others; that plague was not carried by atmospheric air, which would have rapidly scattered it over large areas; that it was not spread by winged or

other insects migrating readily from house to house; but that, of parasitic vermin, it might be carried by bugs, which stick not only to houses, but even to the same pieces of furniture, or by fleas which remain in the earth, sweepings and floors of houses, and which had been suspected to be carriers of famine fever. The consideration shown by Jains to bugs and other insects, which they do not destroy, but are said to go so far as to feed artificially, seemed to me to conform with the hypothesis. The latter idea has been subsequently put on record in the Indian Plague Commission's Report, Vol. V, page 75, paragraph 187.

In reply to my suggestion Dr. Surveyor informed me that he had already examined some bugs caught in the Arthur Road Plague Hospital, with negative results; and Mr. Hankin undertook, prior to observations on other insects, a series of experiments on ants, for which the Jains arrange, it seems, regular feasts in their houses. He carried on these experiments for several months at the Bombay Municipal office, in the Laboratory rooms there, under the auspices of the Municipal Commissioner and the Health Officer, and found that corpses of plague rats were attacked by large numbers of the insects in question; that when they leave such a corpse plague bacilli are discoverable on their feet and antennæ (*vide* Indian Plague Commission's Report, Vol. V, page 129, paragraph 283); that the same species of ants feed on men's food preserved in houses, and which they may contaminate; and that they sometimes bite human beings.

Mr. Hankin was subquently recalled to his substantive appointment in Agra, and left the work on the above stage without having extended it to other insects. On the arrival of Dr. Simond he took over the problem on this stage and undertook an investigation on fleas. The idea seemed to him extremely plausible, and he endeavoured to prove that plague rats were infective only as long as they were covered with fleas; that plague bacilli were discoverable on such fleas; that by means of the latter a plague rat might transmit plague to another rat kept at a little distance from it; and that rat fleas might attack men.

Unfortunately, Dr. Simond's *experiments*, in a large proportion of instances, gave *negative* results; while the cases in which the experimental animal did get the disease were so few that they might be attributed to some adventitious circumstances. Experiments made by Nutall in Cambridge and by certain Italian and German bacteriologists went still further against the hypothesis in question.

The Medical Authorities of New South Wales, and particularly Dr. Ashburton Thompson, President of the Board of Health, Sydney, and Dr. Frank Tidswell, bacteriologist, took this hypothesis as the basis for a plague policy, and the result appeared to them to justify their conclusions. They added a number of theoretical considerations in favour of it, as well as a certain number of experimental facts.

In 1903, Captain Liston, I. M. S., of this Laboratory, compiled the arguments that have been accumulated now in the literature in favour and against this theory and added a certain number of new considerations, *viz.*, that light and cleanliness are apt to affect fleas and plague in a similar way; that the seasonal prevalence of plague might in certain cases correspond to that of fleas, and the concomitance or otherwise of a rat and human plague epidemic might be due to the habits of the particular kind of flea prevalent in the locality; and some others.

He made also many experiments to test these conclusions; but the results were unfortunately similar to those of Simond's, in that out of a large number of attempts, only in one or two did a rat exposed to flea infection contract plague; and as the experiments were carried out in a town where rats were dying of plague naturally, the rarity of this positive result rendered it inconclusive. The matter stands at present on this stage.

(6).—EXPERIMENTS ON CURATIVE SERUM FOR PLAGUE.

Between November 1902 and July 1903, 111 plague patients were treated by us, with serum obtained by the Secretary of State, from Professor Terni,

Messina, in the Modikhana Municipal Plague Hospital, in Bombay. Of these 90 died, while of 112 non-treated and observed for comparison with the treated, 91 died. In the Maratha Municipal Plague Hospital 16 were treated with the same serum in 1904, and 12 died, while of 16 observed for comparison 11 patients died.

Serum prepared by Dr. Brazil, in San Pavlo, and sent to the Laboratory for testing, by the Secretary of State, was applied this year in the Maratha Hospital to 50 patients. Of these 41 died, while of 50 control cases 45 died. In the Modikhana Hospital, of 20 so treated 17 died, and of 20 non-treated, 15. All the above patients were treated by hypodermic injections. Some had very large doses of the material, running into several hundreds of cubic centimeters.

Upon an application from me, Dr. E. Roux, the Sous-directeur of the Pasteur Institute in Paris, very kindly sent us a supply of serum prepared, in that Institute, on the lines worked out by himself, Yersin and Borell.

The supply is sufficient for treating a 100 serious cases. The trial on the same lines as applied to the Terni and Brazil sera is proceeding in the Maratha Plague Hospital. Intravenous injections, as advocated by Calmette and Salimbeni, are now being tried.

A detailed report on the experiment made in 1899-1900 in the Arthur Road Plague Hospital, with Professor Lustig's serum, was submitted to Government in this office letter No. D.-752 of 4th April 1904.

II.

STUDIES AND WORK IN CONNECTION WITH DISEASES OTHER THAN PLAGUE.

A.—TYPHOID FEVER.

(1).—Anti-typhoid Vaccine.

A few correspondents applied for small quantities of anti-typhoid vaccine, and the material prepared in this Laboratory was supplied to them as per attached statement :—

Statement showing the amount of Anti-typhoid Vaccine supplied to various places from the Research Laboratory, Bombay, between 1st June 1902 and 31st March 1904.

Date of despatch.	To whom and where sent.	Number of doses.
	Bombay Presidency.	
	Bombay.	
6th August 1902	... Health Officer	2
	Poona.	
10th June 1902 to 1st July 1902.	Lieut.-Colonel Henderson, I. M. S., Civil Surgeon ...	10
	Sa'ta'ra District.	
	Mahábaleshvar.	
18th November 1902	... Colonel F. Willis, I. M. S.	6
	United Provinces of Agra and Oudh.	
	Lansdowne Cantonment.	
10th June 1902	... Captain Hunter, I. M. S., II and III Goorkhas ...	3
	Mussoori.	
15th September 1902	... Civil Surgeon	2
	Native States.	
	Bombay Presidency.	
	Miraj.	
6th November 1902	... J. Rutter Williamson, Mission Hospital ...	5

(2).—Serum diagnosis of enteric fever.

A number of applicants were supplied with requisites for this diagnosis. In other cases the diagnosis was made at the Laboratory and reported to the medical officers by wire.

B.—SNAKE-VENOM AND ANTIVENENE.

(1).—Collection of Venom.

By the desire of the Government of India the animals which were being immunised at this Laboratory for the preparation of antivenene, and the necessary apparatus, as well as the supplies of snake venom collected here, were sent over, in April 1903, to the Kasauli Laboratory. The amount of venom sent there, *viz.*, that of the Cobra and Russell's Viper, is sufficient for many

years of work. A certain amount of venom of other snakes, *viz.*, the Krait, King Cobra and the Phursa, was similarly supplied. Upon the desire of Government of India, venom is still being collected at the Laboratory for the same purpose. Attached statement shows the number of snakes collected, from different places, during the period under view.

Statement showing the number of live Snakes collected at the Plague Research Laboratory from various parts of India between 1st June 1902 and 31st March 1904.

Name of Presidency or Province from which received.	Date.	Designation of Snakes.						Total number received.
		Naja tripudians.	Daboia Russellii.	Echis carinata.	Bungarus fasciatus.	Bungarus cæruleus.	Non-poisonous snakes.	
Central Provinces ...	5th June 1902 to 30th March 1904.	163	138	100	2	2	...	405
Bombay Presidency ...	17th June 1902 to 5th December 1903.	3	7	175	...	...	...	185
Bengal ...	3rd June 1902 to 30th March 1904.	20	12	...	4	21	3	60
The Punjab ...	17th June 1902 to 11th August 1902.	2	...	16	...	...	1	19
United Provinces of Agra and Oudh.	15th August 1902 ...	4	...	...	...	...	...	4
Madras Presidency ...	30th June 1902 to 8th September 1902.	2	...	...	...	...	...	2
Nizám's Territory ...	11th November 1902...	...	1	...	...	...	...	1
Total ...	3rd June 1902 to 30th March 1904.	194	158	291	6	23	4	676

(2).—Supply of antivenene.

Up to September 1902, 481 bottles of Calmette's antivenene were supplied to various officers as shown in the subjoined statement. From the above date antivenene is being supplied from the Kasauli Laboratory, where it is prepared from the animals immunised there and from those sent from Bombay.

Statement showing the amount of Antivenene supplied to various places from the Research Laboratory, Bombay, between the 1st June 1902 and 30th September 1902.

(Total number of bottles 481.)

Date.	Name of Presidency and Districts and date of despatch.	Number of bottles supplied.
	BOMBAY PRESIDENCY.	
	Bombay.	
1st June 1902 to 2nd September 1902.	Laboratory Officers ...	24
1st August 1902...	Dr. E. S. Winter, Store Officer, Parel.	1
	Total for Bombay Presidency.	25
	BENGAL PRESIDENCY.	
	Berhampur.	
11th July 1902 ...	Medical Officer in charge the Jubilee Hospital.	4
	BENGAL PRESIDENCY —*continued.*	
	Calcutta.	
14th March 1903 to 29th January 1904.	The Surgeon to His Excellency the Viceroy.	17
	Total for Bengal Presidency...	21
	BURMA.	
	Bassein.	
11th July 1902...	Civil Surgeon	
	Henzada.	
11th July 1902...	Civil Surgeon	

Date.	Name of Presidency and Districts and date of despatch.	Number of bottles supplied.
	BURMA—*continued.*	
	Kyaukse.	
11th July 1902	... Civil Surgeon ...	4
	Magwe.	
11th July 1902	... Civil Surgeon ...	4
	Mandalay.	
30th September 1902.	Civil Surgeon ...	12
	Meiktila.	
11th July 1902	... Civil Surgeon ...	4
	Minbu.	
11th July 1902 and 24th July 1902.	Civil Surgeon ...	6
	Myaungmya.	
11th July 1902	... Civil Surgeon ...	4
	Myingyan.	
11th July 1902	... Civil Surgeon ...	4
	Pakokku.	
11th July 1902	... Civil Surgeon ...	4
	Pegu.	
11th July 1902	... Civil Surgeon ...	4
	Prome.	
11th July 1902	... Civil Surgeon ...	4
	Rangoon.	
11th July 1902	... Civil Surgeon ...	4
	Shwebo.	
11th July 1902	... Civil Surgeon ...	4
	Tharrawaddy.	
11th July 1902	... Civil Surgeon ...	4
	Thaton.	
11th July 1902	... Civil Surgeon ...	4
	Total for Burma ...	74
	CENTRAL PROVINCES.	
	Nagpur.	
3rd June 1902 to 23rd August 1902.	Administrative Medical Officer.	150
	Total for Central Provinces ...	150

Date.	Name of Presidency and Districts and date of despatch.	Number of bottles supplied.
	THE PUNJAB.	
	Delhi.	
31st January 1902.	Medical Officer in charge Bengal Provincial Camp.	6
	Karnal.	
22nd September 1902.	Civil Surgeon ...	2
	Simla.	
23rd July 1902	... Surgeon to His Excellency the Viceroy.	3
	Total for the Punjab ...	11
	UNITED PROVINCES OF AGRA AND OUDH.	
	Agra.	
22nd August 1902.	Civil Surgeon ...	4
	Aligarh.	
22nd August 1902.	Civil Surgeon ...	4
	Allahabad.	
22nd August 1902.	Civil Surgeon ...	4
	Almora.	
22nd August 1902.	Civil Surgeon ...	4
	Azamgarh.	
22nd August 1902.	Civil Surgeon ...	4
	Bahraich.	
22nd August 1902.	Civil Surgeon ...	4
	Ballia.	
22nd August 1902.	Officer in Civil Medical Charge.	4
	Banda.	
22nd August 1902.	Civil Surgeon ...	4
	Bareilly.	
22nd August 1902.	Civil Surgeon ...	4
	Benares.	
22nd August 1902.	Civil Surgeon ...	4
	Bijnor.	
22nd August 1902.	Civil Surgeon ...	4
	Budaun.	
22nd August 1902.	Officer in Civil Medical Charge.	4

Date.	Name of Presidency and Districts and date of despatch.	Number of bottles supplied.
	UNITED PROVINCES OF AGRA AND OUDH—*continued.*	
	Bulandshahr.	
22nd August 1902.	Officer in Civil Medical Charge.	4
	Cawnpore.	
22nd August 1902.	Civil Surgeon ...	4
	Chakrata.	
22nd August 1902.	Officer in Civil Medical Charge.	4
	Dehra Dun.	
22nd August 1902.	Civil Surgeon ...	4
	Farukabad.	
23rd August 1902.	Civil Surgeon ...	4
	Fyzabad.	
23rd August 1902.	Civil Surgeon ...	4
	Gazipur.	
23rd August 1902.	Civil Surgeon ...	4
	Gorakhpur.	
29th July 1902 ...	Civil Surgeon ...	8
	Hamirpur.	
23rd August 1902.	Officer in Civil and Medical Charge.	4
	Hardoi.	
23rd August 1902.	Officer in Civil Medical Charge.	4
	Etah.	
22nd August 1902.	Officer in Civil Medical Charge	4
	Jalaun.	
23rd August 1902.	Officer in Civil Medical Charge.	4
	Jhansi.	
22nd August 1902.	Civil Surgeon ...	4
	Kheri.	
23rd August 1902.	Officer in Civil Medical Charge.	4
	Lucknow.	
23rd August 1902.	Civil Surgeon ...	4
	Mainpuri.	
23rd August 1902.	Civil Surgeon ...	4
	Meerut.	
23rd August 1902.	Civil Surgeon ...	4
	Moradabad.	
23rd August 1902.	Civil Surgeon ...	4
	Mussoorec.	
23rd August 1902.	Civil Surgeon ...	4
	Muttra.	
23rd August 1902.	Civil Surgeon ...	4
	Muzfarnagar.	
23rd August 1902.	Officer in Civil Medical Charge.	4
	Naini Tal.	
29th August 1902.	Civil Surgeon for Haldwani Dispensary.	20
	Pratabgarh.	
23rd August 1902.	Civil Surgeon ...	4
	Rae Bareli.	
23rd August 1902.	Civil Surgeon ...	4
	Ranikhet.	
23rd August 1902.	Civil Surgeon ...	4
	Roorkee.	
23rd August 1902.	Civil Surgeon ...	4
	Saharanpur.	
23rd August 1902.	Civil Surgeon ...	4
	Shahjahanpur.	
23rd August 1902.	Civil Surgeon ...	4
	Shrinagar.	
	(Garhwal.)	
23rd August 1902.	Officer in charge Sadar Dispensary.	4
	Sultanpur.	
23rd August 1902.	Civil Surgeon ...	4
	Unao.	
23rd August 1902.	Officer in Civil Medical Charge.	4
	Total for United Provinces of Agra and Oudh ...	192
	NATIVE STATES.	
	RAJPUTANA.	
	Alwar.	
12th July 1902 ...	Agency Surgeon ...	4
	Bikaneer.	
12th July 1902 ...	Civil Surgeon ...	4
	Total for Rajputana ...	8
	Grand Total ...	431

C.—SCORPION VENOM.

A series of experiments were made by Captain Greig, I. M. S., in the direction of ascertaining the minimum lethal dose for animals and studying the effects of the poison upon the blood and blood corpuscles. The experiments were made so far on white mice, for which the venom is very deadly.

D.—BERI-BERI.

The properties of a bacillus isolated from Beri-beri patients, by Professor Axel Holst, of Christiania, were studied experimentally, on brown monkeys. Investigation into the epidemiological features of the disease has led this scientist to the belief that it is conveyed mainly or entirely by food. Monkeys placed, upon his suggestion, in prison cells where cases of Beri-beri had occurred, contracted the disease. The attempts made in this Laboratory to give the latter to the monkey, by food contaminated with the bacillus above mentioned, did not give positive results; but other observations induce Professor Holst to believe still in the specificity of the microbe in question; and he is further pursuing the studies in the matter.

E.—LATHYRIASIS.

Experiments were made in the Laboratory with fowls, pigeons, sparrows, as well as guinea-pigs and rabbits, in order to see whether they are affected by being fed with Jaora grain, which is suspected in the central districts of India to cause specific paralysis in man. The experiments gave a negative result, save in one case of a rabbit which was struck by partial paralysis for a certain number of days, but soon recovered.

III.

OTHER WORK OF PRACTICAL UTILITY CARRIED OUT BY THE LABORATORY.

(1).—Diagnosis of diseases other than plague.

Pathological specimens for purposes of diagnosis were examined in 130 cases of diseases in man, and in 61 of those in animals. The specimens were blood samples (110 cases), tumours (10 cases), sputum (10), internal organs (4), brains (6), &c. The diseases diagnosed were spirillum fever (28 cases), malaria, typhoid (12), anthrax (2), fibro-sarcoma (2), tubercle, diptheria (1), hydrophobia (5 cases), Malta fever (1), &c. This work was carried out mostly by Captains Liston and Greig, and Assistant Surgeon Kapadia.

(2).—Teaching work and facilities for research given at the Laboratory.

(*a*) Surgeon-Major Omar Chevki Effendi and Surgeon-Captain Nehad Reshad Effendi, Surgeons of the Ottoman Army (Bombay Government Resolutions No. 3608-P. of 2nd September 1901, and No. 1075-P. of 25th March 1902) left the laboratory after a prolonged course of study in plague and kindred subjects.

At the request of Dr. A. F. Foy, Port Health Officer of Rangoon, Mr. B. Solomon, appointed as Assistant Surgeon, Port Health Department, Rangoon, was, preparatory to his taking up his appointment, received into the Laboratory and allowed to acquaint himself with the elements of bacteriological work, in their practical bearing on plague.

Similar facilities were given to Dr. Hugh P. Joseph, of the Port Health Department, Colombo.

Upon the application of the authorities of the Gokuldas Tejpal Hospital, Bombay, Hospital Assistants Avari and Hari Krishna were admitted for instruction in preparing pathological specimens, staining slides, etc.

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IV.

THE OFFICERS OF THE PLAGUE RESEARCH LABORATORY.

Subjoined is a list, in chronological order, of the officers who served for various length of time at the Plague Research Laboratory, since its foundation in October 1896, and who contributed to the work done here.

Officers who served at the Plague Research Laboratory from the commencement, the 8th October 1896, to 31st March 1904.

Mr. W. M. Haffkine ...	... 8th October 1896	... To date.
Dr. N. F. Surveyor ...	... 15th January 1897	... 24th June 1897.
	... 19th September 1902	... 28th February 1903.
Dr. R. M. Kalapesi ...	... 1st February 1897	... Up to end of 1897.
Dr. J. B. Quadros ...	... 27th March 1897	... 30th April 1899.
Military Assistant Surgeon R. S. Babonau.	11th June 1897	... 24th September 1897.
Military Assistant Surgeon E. D. Shave.	June 1897	... September 1897.
Lieut.-Col. W. B. Bannerman, I.M.S.,	9th March 1897	... 30th March 1897.
studied at the Laboratory.	1st July 1897	... 21st April 1898.
served at the Laboratory.	... 18th March 1899	... 4th November 1903.
Dr. A. Mayr ...	... 1st February 1898	... 11th June 1899.
Dr. J. T. Leon ...	... 5th February 1898	... 19th February 1898.
Assistant Surgeon P. A. Cordeiro	... 8th February 1898	... 31st March 1900.
Dr. A. S. Paymaster ...	... 9th February 1898	... 8th January 1900.
Dr. R. W. Jameson ...	... 10th February 1898	... March 1898.
Dr. E. S. Winter ...	... 10th February 1898	... 10th March 1898.
	... 20th August 1902	... 4th March 1903.
	... 7th May 1903	... To date.
Dr. F. Anderson ...	... 11th February 1898	... 9th April 1898.
Dr. H. E. Master ...	... In 1898	... 31st March 1898.
Dr. Cayley ...	... 4th March 1898	... August 1898.
Dr. E. L. Marsh ...	... 4th March 1898	... 16th September 1899.
Dr. Knapp ...	... 7th March 1898	... About the middle of 1898.
Dr. W. W. Pitchford ...	... 28th March 1898	... 22nd July 1898.
Lieut.-Col. C. J. H. Warden, I. M. S.	... 2nd April 1898	... 2nd June 1898.
Dr. F. M. Gibson ...	... 18th May 1898	... To date.
Dr. (Miss) A. M. Corthorn	... June 1898	... August 1898.
Assistant Surgeon R. J. Kapadia	... 10th June 1898	... To date.
Captain C. J. R. Milne, I. M. S.	... 13th June 1898	... 6th December 1899.
	... 12th September 1902	... 11th December 1902.
Assistant Surgeon E. Mitchel	... 6th July 1898	... 31st October 1898.
Dr. A. C. Ransome ...	... 4th November 1898	... 27th May 1899.
Dr. W. Hanna ...	... 27th May 1899	... 6th April 1901.
Dr. C. Balfour Steward ...	... May 1898	... 3rd June 1899.
Dr. T. A. Starkey ...	... 16th June 1899	... 15th December 1899.
Assistant Surgeon J. V. P. Mascarenhas.	6th July 1899	... .
Dr. G. Taylor ...	... 21st October 1899	... 26th October 1899.
	... 29th November 1899	... .
Captain G. Lamb, I. M. S.	... 6th November 1899	... 29th December 1902.
Dr. M. K. Pansare ...	... 12th January 1900	... To date.
Assistant Surgeon J. P. Pocha	... 2nd March 1900	... To date.
Dr. E. L. Hunt ...	... 15th June 1900	... 31st May 1901.
Captain W. G. Liston, I. M. S.	... 12th June 1901	... 11th January 1902.
	... 5th January 1903	... 13th October 1903.
Captain E. D. W. Greig, I. M. S.	... 10th February 1902	... On deputation with Sleeping Sickness Commission, Uganda, from 30th April 1903.
Dr. E. Maynard ...	... 22nd July 1902	... 20th December 1902.
Dr. H. C. Venis ...	... 25th August 1902	... 13th December 1902.
Dr. C. T. Costello ...	... 22nd September 1902	... 12th December 1903.
Dr. W. G. West ...	... 22nd September 1902	... 23rd February 1903.
	... 2nd February 1904	... To date.
Dr. J. W. Van Millingen ...	... 3rd November 1902	... 10th November 1902.
Dr. J. H. Walsh ...	... 10th November 1902	... 28th February 1903.
Dr. J. S. C. Elkington ...	... 8th December 1902	... 6th May 1903.
Dr. J. W. Miller ...	... 9th December 1902	... 28th February 1903.

W. M. HAFFKINE,
Director-in-Chief, Plague Research Laboratory.

Bombay, 21st April 1904.